Measuring Turbulence Mixing in Indonesian Seas using Microstructure EM-APEX Floats

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LONG-TERM GOALS

In collaboration with Ren-Chieh Lien [Award Number: N00014-15-1-2318] of the Applied Physics Laboratory University of Washington, the long-term scientific goals are to understand the dynamics and identify mechanisms of small-scale processes—i.e., internal tides, inertial waves, nonlinear internal waves (NLIWs), and turbulence mixing—in the ocean and their interaction with oceanic processes at larger scales. We aim to develop improved parameterizations of mixing for ocean models. For this study, our focus is on the turbulence mixing in Indonesian Seas, the surface mixed layer processes, inertial waves and internal tides, oceanic responses to atmospheric forcing, and effects of oceanic processes on air-sea fluxes. The ultimate goal is to improve our understanding of the atmosphere-ocean coupled system in Indonesian Seas.

OBJECTIVES

The primary objectives of this observational program are to quantify turbulence mixing and identify dominant small-scale processes in the upper ocean in Indonesian Sea, and their effects to the modulation of sea surface temperature and air-sea fluxes.

APPROACH

We are proposing an innovative method to measure turbulence mixing in these regions, where we expect vigorous diapycnal mixing activity, using the autonomous microstructure EM-APEX floats. These floats measure turbulent thermal diffusion rate, horizontal velocity, temperature and salinity, vertical shear, stratification, and thereby the Richardson number. Estimates of turbulent kinetic energy dissipation rates and eddy diffusivity can be inferred. Microstructure EM-APEX floats were used in the prior ONR LatMix experiment, where they obtained quality microstructure and small-scale measurements. We will deploy microstructure EM-APEX floats in one or more of these regions, each with different mixing environments: Banda Sea, Flores Sea, and south of Makassar Strait.

WORK COMPLETED

A.L. Gordon contributions: Participate in the selection of the site for the EM-APEX deployment consistent with the cruise plans as they develop; advising the APL/UW team on acquiring documents

and approvals within Indonesia system. The APL/UW team established Memorandum of Understanding (MoU) and Letter of Agreement (LoA) between Bogor Agricultural University and Applied Physics Laboratory at University of Washington. Approval of Foreign Research Permit from RISTEK (Ministry of Research and Technology at Indonesia) was obtained in August 2015. APL engineers have updated the software of EM-APEX floats, and prepared and test floats. The monsoon wind forcing, and thereby upper ocean mixing, is the strongest during the boreal summer, and the weakest in fall. We are in the process of discussing with our Indonesian collaborators to determine the most proper cruise to conduct the experiment.

IMPACT/APPLICATION

Oceanic processes in the Indonesian Seas play an important role in modulating the sea surface temperature and air-sea fluxes. Quantifying turbulence mixing and identified dominant oceanic processes in the upper ocean in Indonesian waters will help improve our understanding of the ocean-atmosphere coupling processes and effects on the Madden-Julian Oscillations.

HONORS/AWARDS/PRIZES

Houghton Lecturer, Massachusetts Institute of Technology. spring semester 2015